

CROSSOCHIR KOELZI: A NEW CALIFORNIAN SURF-FISH OF THE FAMILY EMBIOTOCIDAE

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In the preparation of a monographic review of the fishes of the family Embiotocidae—the viviparous perches of the North Pacific—it has become evident that one of the most distinct species of the California coast has remained unnamed. The characters of this form are, however, so clear that a new genus appears needed for its sole reception.

This form has only once been distinguished. In my 1918 revision of the family, it was keyed out as *Holconotus rhodoterus*, which among previously named forms is probably its closest relative. In preparing that revision, I had specimens of *Crossochir* but none of the true *Holconotus* at hand, and so rather naturally made the misidentification, no more suspecting than did Dr. David Starr Jordan or other ichthyologists that an unnamed species existed in this well-studied family.

The distinguishing features of *Crossochir koelzi*, the new genus and species, and of other members of the subfamily Amphistichinae are indicated in the following key:

KEY TO THE GENERA AND SPECIES OF THE EMBIOTOCID SUBFAMILY AMPHISTICHINAE

- a*¹. Anal fin of breeding male without definite horny excrescence and huge flasklike gland, but with one ray (about the twelfth, at the angle in the fin base) enlarged and ossified into a strong triangular plate with serrated edge, and with the next ray following also somewhat strengthened (in the female the homologous rays are somewhat modified in the same direction, sufficiently so for purposes of identification). No oval depression on body near front of anal fin. No sexual variation in number of fin rays or vertebrae. Spinous portion of dorsal shorter than the soft part. Teeth unicuspid, in two series in each jaw (the inner row of lower jaw more or less confined to front of jaw). (Subfamily Amphistichinae.)

- b*¹. Lower lip with posterior groove continuous across chin. Mouth decidedly oblique, rising to opposite lower part of eye anteriorly.

- c*¹. Dorsal spines rather slender and weak, abruptly graduated to the long middle spines, behind which the margin of the fin is nearly straight. Anterior interneurals not greatly strengthened, with low and blunt lateral ridges. Pectoral fin longer, with upper edge nearly straight to tip, and lower rays only slightly frayed and silky. Fins pale, with or without black markings.
- d*¹. Lower jaw very strong, projecting forward at the symphysis beyond the upper, so that the teeth of the two jaws are far from being opposed. Body more nearly oblong (depth about two-fifths standard length). Anal fin relatively short, with fewer than 25 soft rays.
- e*¹. Gill rakers long and numerous (about 20 below angle). Mouth strongly oblique. Vertebrae 32 (15 + 17), of which only 11 support anal base. Dorsal and ventral contours about equally curved. Body rather strongly compressed.
- f*¹. Eye little enlarged (about one-fifth length of head). Anterior ventral edge not sharpened or strongly curved. Color: Sides not barred; pelvic fins plain; anal with a black blotch----- *Hypocritichthys analis*
- d*². Lower jaw less prominent; the teeth of the two jaws nearly opposed. Body more rounded and deeper (depth about half standard length). Anal fin longer, with more than 28 soft rays.
- e*². Gill rakers relatively long and numerous (more than 15 below angle). Mouth excessively oblique. Vertebrae 33 to 35, of which 12 to 14 support the anal base. Dorsal contour somewhat less strongly curved than the ventral. Body very strongly compressed.
- f*². Eye excessively enlarged (about two-fifths length of head). Gill rakers longer, and more than 20 below angle of first arch. Anterior ventral edge blunter and less strongly curved. Color: Sides occasionally faintly barred; pelvic fins black distally; anal without black edge or blotch----- *Hyperprosopon argenteum*
- f*³. Eye moderately enlarged (about one-third length of head). Gill rakers shorter; fewer than 20 below angle of first arch. Anterior ventral edge rather sharp and very strongly and evenly curved. Color: Sides rather faintly barred; pelvic fins plain; anal fin with an inky-black margin----- *Tocichthys ellipticus*¹
- e*³. Gill rakers relatively short, thick and few (only 11 to 13 below angle). Mouth only moderately oblique. Vertebrae 32 (14 + 18), of which only 11 support the anal base. Dorsal and ventral contours about equally curved. Body less strongly compressed.
- f*⁴. Eye smaller. Anterior ventral edge blunt and not very strongly curved. Color: Sides rather strongly barred; fins without black markings, but reddish (especially the caudal)----- *Holconotus rhodoterus*

¹This is the species previously called *Hyperprosopon agassizii*. On its nomenclature, see Hubbs (1918 and 1928). The supposed difference in dentition, pointed out in the original diagnosis of *Tocichthys*, does not hold well.

- c*². Dorsal spines extremely robust and much shorter than the dorsal rays; margin of spinous fin rather evenly rounded. Anterior interneurals very strong, with sharply expanded lateral keels. Pectoral fin shorter and with upper margin strongly curved downward toward tip, so that the fin is more nearly symmetrical than in any other embiotocid; lower rays of pectoral more frayed and silky than in any other genus. Fins mostly dusky (in preservative; probably deep red in life).
- d*³. Lower jaw not very prominent; the teeth of the two jaws opposed. Body deep (depth about half standard length). Anal fin rather long, with 25 to 31 soft rays.
- e*⁴. Gill rakers moderate in length and number (14 to 17 below angle). Mouth only moderately oblique. [Vertebrae not examined.] Dorsal contour much more strongly curved than the ventral. Body not very sharply compressed.
- f*⁵. Eye moderate (about one-fourth length of head). Anterior ventral edge blunt and but little curved. Color: Body speckled, with trace of bars; fins without black markings..... *Crossochir koelzi*
- b*³. Lower lip with the posterior groove interrupted by a broad frenum. Mouth little oblique, not rising to opposite eyes anteriorly.
- c*¹. Dorsal spines, spinous dorsal, and interneurals intermediate between those of groups *c*⁴ and *c*². Pectoral fin as in *c*¹. Fins pale.
- d*⁴. Lower jaw and teeth as in *d*³. Body rather slenderer, distinctly less than half as deep as long. Anal fin averaging shorter, with about 25 soft rays.
- e*⁵. Gill rakers short and few, as in *Holconotus*. Mouth very weakly oblique. Vertebrae 29, of which only 10 support the anal base. Dorsal contour somewhat more strongly curved than the ventral. Body relatively thick.
- f*⁶. Eye rather small. Anterior ventral edge blunt and little curved. Color: Strongly though irregularly barred; fins without black markings... *Amphistichus argenteus*

CROSSOCHIR, new genus

The characters of this genus are those given successively in items *a*¹, *b*¹, *c*², *d*³, *e*⁴, *f*⁵, of the preceding key. Its relationships appear to be most intimate with *Holconotus*, though it is almost equally close to *Amphistichus*. From the latter it differs trenchantly in lacking the frenum, and is further distinguished by the more oblique mouth and deeper body, and usually by the longer anal fin. It differs from *Amphistichus* weakly, and from *Holconotus* more decisively, in the stronger and lower dorsal spines, more rounded spinous dorsal, and stronger and more keeled interneurals. From both *Amphistichus* and *Holconotus*, as well as other genera, it differs in having the pectoral fin shorter, with more arched upper edge and

frayed and silky lower rays. From those two genera *Crossochir* differs further, though not very trenchantly, in having the gill rakers somewhat longer and more numerous, approaching those of the remaining genera of the Amphistichinae. In addition to having shorter and fewer gill rakers, *Crossochir* also differs from these other genera in the dorsal spine and interneural characters, as well as in other respects. The color of the type species gives *Crossochir* a distinctiveness of appearance sufficient for quick identification.

The type and only known species is *C. koelzi*, herein described.

The name *Crossochir* (fringed hand) refers to the frayed and silky lower pectoral rays.

CROSSOCHIR KOELZI, new species

PLATE 1

Holconotus rhodoterus YARROW and HENSHAW, 1878, p. 205 (Santa Barbara record not checked); BEAN, 1880, p. 88 (San Diego record not checked; Santa Cruz Island and Santa Barbara records checked); JORDAN and GILBERT, 1881a, p. 456 (Monterey Bay and Santa Barbara records checked); JORDAN and JOUY, 1881, p. 10 (Monterey and Santa Barbara records checked); JORDAN and GILBERT, 1881b, p. 50 (Santa Barbara record checked; Tomales and Soquel records may also apply to this species); EIGENMANN, 1892, p. 156 (San Diego, in surf; record not checked); EIGENMANN and EIGENMANN, 1892, p. 354 (San Diego record not checked; Santa Barbara and Monterey records checked); GILBERT, 1895, p. 466 (San Simeon Bay record, checked by Myers); HUBBS, 1918, p. 12 (diagnosis, in key).

Amphistichus rhodoterus EIGENMANN and EIGENMANN, 1890, p. 9 (San Diego record not checked; life colors).

In recording this species repeatedly under the name of *rhodoterus*, none of the authors quoted indicated any doubt in the identification. An examination of the synonymy of *Holconotus rhodoterus* (and of other embiotocids), as given by Eigenmann and Ulrey (1894, p. 388) and by Jordan and Evermann (1898, p. 1502) gives no indication that a name has ever been proposed for the present species. *Cymatogaster pulchellus* and *C. larkinsii*, as nearly as can be told from the original diagnoses by Gibbons (1854), are based on the true *Holconotus rhodoterus* Agassiz. All three nominal species were described from San Francisco, where *rhodoterus* is common.

Another quoted synonym of *Holconotus rhodoterus*, *Cymatogaster ellipticus* (Gibbons, 1854), is clearly the species later called *Hyperprosopon* or *Tocichthys agassizii*, as I have already indicated (1928, p. 12). On the other hand, *Embiotoca* or *Ennichthys heermanni* Girard, from Cape Flattery, should certainly be restored to the synonymy of *Holconotus rhodoterus*. It was properly so placed until 1890, when Eigenmann and Eigenmann transferred the name to the synonymy of *Amphistichus argenteus*, presumably because their "*Holconotus rhodoterus*" was another species (*Crossochir*

koelzi). This false synonymy, persisting until my correction in 1928, gave rise to a bad error in statement of ranges: *Holconotus rhodoterus* was said to range northward only to San Francisco, whereas it is abundant along the surf of Oregon and Washington, and *Amphistichus argenteus* was said to range northward to Cape Flattery, whereas there are no authentic records north of San Francisco.

The range of *Crossochir koelzi*, as determined from the literature records and from the type specimens, is central and southern California, from Drakes Bay to San Diego, and thus approximately coincides with that of *Amphistichus argenteus* and overlaps that of *Holconotus rhodoterus* about San Francisco. So far as checkable, all records of *H. rhodoterus* from south of San Francisco were based on *Crossochir koelzi*. What little is recorded as to its habitat indicates that this species, like its nearest relatives *Holconotus rhodoterus* and *Amphistichus argenteus*, is essentially an inhabitant of the surf, ordinarily penetrating the bays only to their more open portions.

Specimens examined.—Holotype: U.S.N.M. No. 26901, a specimen 198 mm long to caudal, collected by Jordan at Santa Barbara, Calif., in 1880.

Paratypes in National Museum, 135 mm to 208 mm to caudal: Another specimen from the holotype lot; No. 26933, 3 specimens, same data; No. 27074, Monterey, Calif., Jordan, 1880; No. 47110, Santa Cruz Island, Calif., seined, *Albatross*, 1889; No. 54726, Drakes Bay, Calif., *Albatross*.

Paratype in Museum of Comparative Zoology: One adult female, 186 mm long, collected in California by A. Agassiz.

Paratype in Scripps Institution of Oceanography: One adult female, 210 mm long, collected by Percy S. Barnhart in the surf at La Jolla, Calif., in the spring of 1926. Another specimen from La Jolla is in the same institution, according to Mr. Barnhart.

Paratypes in Field Museum of Natural History: No. 7618, 3 specimens 132 to 175 mm long, from San Diego, Calif.

Paratypes in Museum of Zoology, University of Michigan: No. 64225, one half-grown female, 107 mm long, Santa Cruz Island, Calif., seined, *Albatross*, 1889; No. 95030, Scripps Institution Pier, La Jolla, Calif., collected by Percy S. Barnhart in April, 1927.

Specimens (not paratypes) in Stanford University collection (identifications kindly furnished by George S. Myers): No. 2726, five from Santa Cruz Island, Calif.; No. 5364, one from San Simeon Bay, Calif.

Appreciation is expressed to the authorities of the several institutions just named for permission to use their material of this new species as the basis for the present paper.

Description, based on the holotype and all paratypes (counts and measurements of paratypes given in parentheses).—The body is rather deep; depth, not including dorsal sheath, 1.8 (1.8 to 2.1). It is moderately compressed; width, 3.4 to 3.7 in depth. The least depth of the high and thin caudal peduncle is contained 1.7 to 2.2 times in the head. The caudal peduncle is almost twice as deep as its length measured on midline behind vertical from end of anal base. The dorsal contour is decidedly more sharply curved than the ventral; as a whole, it is a high, even arch, but is gently concave in the nuchal region.

The head is a thick, blunt, almost symmetrical cone as seen from the side. The mouth, moderately oblique, rises to opposite lower part of eye. The eye is of moderate size, and the interorbital moderately convex. Length of head, including opercular membrane, 3.4 (3.2 to 3.5) in standard length. Least fleshy interorbital width, 3.6 (3.2 to 4.3) in head; least suborbital width, 2.4 (2.1 to 3) in orbit; greatest diameter of orbit between rims, 3.7 (3.5 to 4.1) in head; length of upper jaw, 2.7 (2.65 to 2.9).

The teeth are in two rows in the upper jaw (sometimes so irregular backward as to appear to form three rows; sometimes uniserial at extreme end of band). In the lower jaw, the teeth are biserial in front, but become irregularly uniserial on the sides. The teeth in the outer row in each jaw are considerably enlarged, somewhat curved, scarcely incisorlike.

The gill rakers are of moderate length and number. The longest is contained 1.7 (1.6 to 2.2) times in the orbit. The number on the first arch is 9 (6 to 8) + 16 (14 to 17) = 25 (21 to 23).

Scales, 66 (61 to 68) in lateral line to end of hypural; $6\frac{1}{2}$ ($7\frac{1}{2}$ in one) rows between middle of sheath along first dorsal and lateral line; 22 (20 to 24) in a series from origin of anal to lateral line.

Dorsal rays XI (X or XI, usually X), 26 (24 to 28); anal rays III, 29 (25 to 31); principal caudal rays 14 (outer pair unbranched; 13 in one); pectoral rays, 26 (25 to 29).

The spinous dorsal is relatively low and rounded. The first four spines are short, and graduate rather slowly and evenly; the fifth to seventh are subequal (the sixth rarely considerably the longest); the following spines are progressively shortened. The heteracanthous dorsal spines are very strong, and as a consequence the supporting interneurals are also much strengthened, and produced outward as sharply expanded keels. The soft dorsal is almost straight-edged (slightly convex to slightly concave). The first soft ray is about one-third higher (rarely scarcely higher) than the highest spine, which, measured from the top of the scaly sheath, enters the head 2 (1.8 to 2.9) times.

The caudal fin is wide, with the lobes not sharply pointed. The inner edge of the shortest ray is contained 1.65 (1.5 to 1.8) times in length of longest ray. The strong caudal rays are almost fan-shaped.

The characteristic pectoral fins are a little shorter than the head (rarely as long), and have the upper edge arched (sometimes not very strongly); the tip more rounded than in related species and the lower edge nearly straight. The lowermost several rays are weak and frayed out to a rather silky fringe, almost as in *Gobius* (in some specimens this modification is less evident than in others, and an approach in the same direction is shown by related species).

The pelvic fins do not quite extend to the origin of the anal in the female, but slightly pass this point in the males.

The anal fin of the male shows to a well-developed degree the modifications characteristic of the Amphistichinae. In this sex the anterior rays form a lobe that is considerably lower than the posterior part of the fin. The several posterior rays of this lobe are considerably thickened about one-third the way out and again near the edge of the fin. In these thickened portions, the articulations of the rays are increased in size and distinctness, whereas elsewhere on these rays the articulations are almost fused. This modification becomes exaggerated toward the posterior end of the lobe. Located at the angle between the two lobes of the fin, one soft ray, the tenth to fourteenth, is grossly exaggerated to form a triangular plate. This is made up of the many branches of the ray, largely fused, and spread out to form a somewhat sawlike edge. The somewhat thickened anterior edge of the plate underlies a fleshy ridge, which becomes enlarged to form a well-marked lobe near the fin margin. Just anterior to this lobe, and just within the outer thickened portions of the rays, another dermal thickening is developed. The posterior edge of the triangular plate is expanded outward and backward on each side, medially, to form a rough-edged bony lobe. The ray next following the one modified into the plate is also considerably widened and somewhat thickened, and has a serrated lobe on both edges on each side. The next following ray is normal in structure, but is a little wider than those that follow. All these secondary sexual modifications of the anal fin are shown to a small degree by the females. In that sex the anterior rays are not shortened as in the male but form a convex lobe, which is set off by only a shallow emargination from the much straighter posterior portion of the fin. The highest anal ray in the female is contained 2.8 (2.6 to 3.3) times in the head.

In alcoholic specimens the body is silvery, with numerous small, scattered, brown flecks, deeper than long, producing an effect somewhat resembling *Eupomotis*. Many of the spots are paired, and

these doubled spots are roughly aligned vertically to form a definite suggestion of narrow bars. Some specimens show a trace of three rows of small blotches, each row parallel with the dorsal contour. The fins become dusky to blackish outward, but show no definite black markings.

The life colors of what was almost certainly an example of this species from San Diego were thus described by Eigenmann and Eigenmann (1890, pp. 9-10):

Silvery, the body profusely covered from dorsal to anal and ventral fins, with squarish, bronze spots, the color being exactly like that which forms bars and spots on *A. argenteus*, except that the brassy color in *argenteus* is modified only by black dots, while in *rhodoterus* the brassy color is modified by both black and scarlet dots, the scarlet making the sides appear to be strongly tinged with red. The brassy ground color of the spots is not resolved into dots by the aid of a pocket lens, but appears as if evenly applied, and the red and black dots sprinkled upon it. Dorsal surface backward to insertion of dorsal fin, olive; a blue metallic reflection above lat. line from nape backward. Ventral surface backward to base of ventrals strongly scarlet tinged, the red and black dots aggregated on the breast to form crescents parallel with the scale margins; premaxillary posteriorly, and maxillary, cheeks and opercles also strongly red tinged, this region and the breast appearing, at a glance, to be "bloodshot."

All the fins, except the pectoral, blackish at tips and reddish tinged; an olive streak through the dorsals which is most conspicuous anteriorly. Pectorals reddish at base, otherwise plain and slightly olivaceous.

Percy S. Barnhart, of the Scripps Institution of Oceanography, writes that the specimen he collected at La Jolla had in life almost exactly the color of *Amphistichus argenteus*.

This species is dedicated to the well-known explorer Walter Koelz, in recognition of his studies on the American coregonid fishes.

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